940 Lansdowne

CONCENTRATIONS OF POLYCHLORINATED BIPHENYLS IN SOIL IN THE VICINITY OF CANADIAN GENERAL ELECTRIC Co. Ltd., 940 LANSDOWNE AVE., TORONTO

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HISTORICAL INFORMATION

Canadian General Electric Co. Ltd. has operated the plant at 940 Lansdowne Ave. since 1901. The company has manufactured low and high power electric utility transformers since 1921. Polychlorinated biphenyls (PCBs) were used as a di-electric fluid in the transformers manufactured at CGE since the early 1940's. The PCBs were not manufactured on site, but were brought in by railway tank car. CGE discontinued the use of PCBs in 1977 when concerns regarding the environmental hazards of this chemical became evident.

An environmental consultant retained by CGE identified significant PCB soil contamination centered around two locations on company property -building No. 36 and the adjacent building No. 26. PCBs were transferred from the railway tank cars and stored prior to use in a closed manufacturing process at these two sites. As PCBs were not vented to atmosphere during transformer construction, the resultant contamination must have occurred from spills and leaks during the transfer and storage operations.

STUDY OBJECTIVE

It was hypothesized that because of the amount of PCB used by CGE, the length of time the chemical was in use (35 years) and the degree of soil contamination on CGE property, soil contamination in the surrounding residential properties could have occurred. PCB is a sticky, viscous fluid with an extremely low water solubility and is strongly adsorbed onto solids, such as soil particles. The primary mode of off-property contamination would be through re-entrainment which involves the migration of a contaminant from an area of high concentration to an area of low concentration through ground level physical and/or mechanical contact. Soil or road dust contaminated with PCBs can adhere to the tires of vehicles, and can be dispersed as the vehicle travels along the roads in the surrounding neighborhood. In this manner the areas adjacent to Lansdowne Ave., Davenport Rd. and Dupont St. would be expected to have the highest off-property PCB soil concentrations. Similarly, leaking railway tank cars and the traffic volume along the CNR and CPR rights-of-way would make the track road bed another potential source of re-entrained contamination. PCBs deposited along the main traffic arteries would slowly spread laterally via surface water movement and ground level winds.

In January 1984 the Toronto Board of Health requested that the Ontario Ministry of the Environment conduct a soil survey for PCB contamination in the residential area surrounding CGE. The request was passed to the Phytotoxicology Section of the Air Resources Branch and the soil survey was conducted on May 16, 17 and 18, 1984. Limited re-sampling was performed on August 24, 1984. The objectives of the study were to (1) determine if PCB soil contamination had occurred off CGE property; (2) define the degree and extent of any contamination; and (3) identify the source of the contamination.

SAMPLE SITE LOCATION

Forty sites were selected for soil sampling. Twelve of the sites were on residential properties, 10 were municipal/religous (schools, street boulevards, churches and parks), 8 were located on CGE property, 5 on the

CNR or CPR rights-of-way, 4 were commercial locations (not CGE or railway) and one site was on land owned by the provincial government. Five of the 40 sample sites were control locations. Three of the control sites were from residential/commercial properties in urban areas similar to the study area but ranging from approximately 2.2 km to 9.0 km distance from CGE. The remaining two control locations were rural sites outside of the City of Toronto. The 35 soil sample sites in the vicinity of CGE were within 700 m of building No. 36. The approximate location of these sample sites is illustrated in Figure 1. Building No. 36 is the small rectangular structure immediately W of site 26. A precise description of all 40 sites is available in Appendix 1.

Soil was sampled relative to the major traffic arteries and railway rights-of-way as areas most likely to become contaminated through re-entrainment. Wind direction would have little bearing on PCB dispersal as the wind at ground level in an urban area would not necessarily reflect the ambient direction. However a review of the meteorological data revealed winds from all directions are common with a slight tendency towards W and SW during the non-winter months.

Soil was sampled on CGE property for two reasons. First, to establish a concentration gradient to see how much of the PCBs known to have contaminated soil on company property has migrated into the surrounding community. Second, to determine if PCBs found in the soil off-property is the same as the PCBs in soil on CGE property thereby confirming CGE as the source.

SAMPLING PROCEDURE AND PRECAUTIONS

Previous Phytotoxicology PCB soil studies have revealed that PCBs normally are below detection limits (0.01 ppm) in urban soil in the absence of a contaminating source. Occasionally levels in the range of 0.01-0.1 ppm are detected without any apparent source being identified. For this reason a number and variety of control sites were included in the soil sampling program. Also, an elaborate sampling procedure was employed to prevent cross contamination as a result of PCBs adhering to the sampling equipment.

Briefly, the sampling procedure for PCBs is the same used for other toxic and/or tenacious organic compounds where high resolution (low ppm) analyses are required. Cross-sample contamination was controlled by using laboratory-clean sampling equipment at each site. The soil corer was washed with an alconox solution and rinsed with distilled water. The washing step was repeated until all visible soil residue was removed. This was followed by a rinse with 95% denatured alcohol to completely dry the equipment. To remove any residual trace organics which may have adhered to the chromed surface of the sampling corer it was then rinsed with 1,1,1-trichloroethane.

To further minimize any possibility of cross-site contamination all sites were assumed to be contaminated relative to their distance from CGE; accordingly within the survey area the sites farthest from CGE were sampled first, followed by progressively closer locations. The field personnel wore clean disposable plastic gloves at each site so that the soil was never touched by unprotected hands.

A 2 m diameter circular plot was established at each of the 40 sample locations. Actual sample collection from within each plot consisted of 15 to 20 soil plugs 2 cm in diameter and 5 cm in depth, yielding approximately 500 g of soil. The soil was placed in wide-mouth, amber-coloured glass jars which had been solvent-rinsed in preparation for organic samples. The sample jar lid was foil-lined and secured with tape when sample collection was completed. The filled sample jars were placed in a light-tight, insulated cooler until delivery to the laboratory.

ANALYTICAL PROCEDURE

The samples were delivered to the Organic Trace Contaminants Section of the Laboratory Services Branch at the Environment Ministry's main laboratory at Hwy. 401 and Islington Ave., Toronto.

The analyses are conducted using electron capture gas chromatographic methodology (Handbook of Analytical Methods for Environmental Samples - MOE, 1983). The analytical detection limit is 0.01 parts per million (ppm) on a dry weight basis.

RESULTS AND DISCUSSION

The results of the analyses are listed in Table 1. The highest soil PCB concentration detected was 400 ppm at sample site 30 located on the CPR right-of-way approximately 175 m E of CGE building No. 36. A replicate sample at the same site yielded a result of 280 ppm. Soil from the ditch adjacent to the CPR tracks (Site 24, 65 m WSW of building No. 36) had a PCB concentration of 210 ppm. A grassy area on the W side of Lansdowne Ave. on company property (Site 26, 30 m E of Bldg. No. 36) had 130 ppm PCBs in the surface soil. The highest off-CGE or railway property PCB level was 2.7 ppm at Site 20, a municipal property, 170 m SSE of CGE at the SE corner of Dupont St. and Lansdowne Ave. The highest PCB soil concentration detected on residential property was 0.51 ppm at Site 10, 340 m NE, of CGE. A similar concentration of 0.54 ppm PCB, was found in soil adjacent to the sidewalk (municipal property) on the N side of Davenport Rd. opposite Wiltshire Ave. (Site 4, 525 m NNW of CGE).

The MOE guideline for PCBs in soil is 50 ppm. The U.S. Environmental Protection Agency has the same PCB soil guideline. None of the municipal, commercial or residential properties sampled exceeded the 50 ppm guideline. One of the sites on CGE property and two of the samples collected along the CPR right-of-way exceeded the provincial criterion.

The data listed in Table 1 are illustrated in Figure 2. The sites where replicate soil samples were collected are represented by both analytical results separated by a slash. These data reveal that there is a clear gradient of PCB soil contamination relative to CGE building No. 36. PCB soil levels decreased rapidly with increasing distance. The highest PCB concentrations were found along the major traffic and railway rights-of-way, confirming the hypothesis of contamination through re-entrainment.

None of the control sites contained PCBs above the detection limit. Also, 5 sites within the survey area had no detectable (ND) PCB concentrations. These locations tended to be the more distant sites. Contrarily, none of the sample sites in close proximity to CGE were free of PCBs. In addition several of the soil sample locations on the edge of the

map in Figure 2 contained PCBs at levels about 10 times higher than the detection limit. Therefore, the extent of PCB soil contamination exceeds 500 m in all directions from CGE Bldg. No. 36, particularly N along Lansdowne Ave. and W along Davenport Rd. and Dupont St.

All the PCBs were identified as Aroclor 1260. The contamination found off-property was spectographically finger printed as the same PCB type detected from the CGE soil samples, therefore confirming CGE as the source. Also, the levels detected in the off-property soil samples were substantially lower than those found on CGE property, indicating that very little of the PCB known to have contaminated CGE property has migrated into the surrounding community.

AUGUST RESAMPLING

When the preliminary laboratory results were reviewed concerns were expressed regarding the unexpectedly high level of 400 ppm at sample site 30. This was the highest level encountered in the survey and it was not believed to be related to historical operations in the vicinity of CGE building Nos. 36 or 26. As soil PCB concentrations at this site were 8 times the 50 ppm criterion, the Phytotoxicology Section was requested to resample in the vicinity of Site 30 to define the local extent of contamination for possible soil removal action.

The precise location of each sample in the survey area could not be found (the sites were not staked) although field notes identified the 2 m collection area to within a few meters. On August 24, 1984 soil was resampled in the general area of Site 30, plus 10 m both E and W and three additional spots on the opposite side of the tracks. In total, 6 new sites were sampled, which completely bracketed the vicinity of the original site 30 (this explains the 6 dots in Figures 1 and 2 at this location). In addition each location was sampled in duplicate.

The results of these 12 samples are listed in Table 2, in addition to the levels originally detected during the May collection. The highest PCB concentration was 6.1 ppm and the lowest was 1.7 ppm. The 12 samples

averaged 2.9 ppm PCBs in surface soil. The mean of the 6 samples on the N side of the tracks was almost twice as high as the sample mean for the S side of the CPR tracks (3.8 vs 2.0). The excessive levels detected during the first (May) survey were not encountered in August. Because the May collection at this site was replicated and both samples returned high PCB concentrations the data was concluded to be accurate. Consultation with CGE and MOE Central Region lead to the supposition that the high levels could have resulted from a single leak in a stationary tank car creating a small isolated spill site. Regardless of its origin the August sampling confirmed that soil contamination along this section of the CPR road bed is not extensive.

IMPLICATIONS OF SOIL CONTAMINATION

The PCB concentrations detected in surface soil off-CGE or railway property do not exceed the 50 ppm guideline. The highest level (2.7 ppm) is 19 times lower than the guideline and the mean PCB concentration (0.42 ppm) from the municipal, residential and commerical properties is 119 times lower than the guideline.

PCBs are relatively immobile in the soil and contamination of the magnitude found in the vicinity of CGE will not result in the accumulation of detectable levels of PCBs in the edible portions of crops grown in urban vegetable gardens. Although the literature regarding plant uptake of PCB is limited it does suggest that PCB accumulation in plants generally is low. Factors affecting plant uptake from soil include PCB concentration, degree of chlorination, length of growth cycle, plant species and organic matter content of the soil. In experiments with carrots (known accumulators of lipophilic chemicals) no detectable PCB residues were detected after 120 days of growth in soil containing 0.05 ppm PCB. In another test using 100 ppm PCB (Aroclor 1254) accumulation was documented with 97% of the PCBs being found in the peel, suggesting that very little translocation occurred in the plant tissue (Strek and Weber, 1982).

CONCLUSIONS

1. *Surface soil (0-5 cm depth) in the residential community in the immediate vicinity of the CGE plant at 940 Lansdowne Ave. is contaminated with low levels of PCBs.*

2. *Contamination above current detection limits (0.01 ppm) was found to extend more than 500 m in all directions from CGE Building 36.*

3. *Analytical speciation of PCBs in soil samples from the residential area confirmed that the source of this contamination is the CGE property.*

4. *Off-CGE property contamination appears to have occurred through re-entrainment and subsequent migration of PCBs from spill sites on company property.*

5. *None of the residential, municipal or commercial properties sampled (excluding CGE or railway property) had PCB soil levels which exceeded the MOE 50 ppm guideline, with the highest level (2.7 ppm in a municipal location) and the survey area mean level (0.42 ppm) being lower than the guideline by factors of 19 and 119, respectively.*

6. *Based on information in available scientific literature the low level PCB contamination of soil detected off-CGE property should not inhibit plant growth or result in detectable root uptake by food crops grown in neighborhood vegetable gardens.*

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TABLE 1: PCB Concentration of Surface Soil (0-5 cm)

Sample Site (Map No.)	Distance and Direction from C.G.E. Bldg. 36	Property Tenure	Parts per Million[t] PCB (Aroclor 1260)
1	670 m NW	church	0.22
2	330 m NW	residential	0.30
3	430 m NW	residential	0.12
4	525 m NNW	municipal	0.54
5	535 m N	municipal	0.21
6	335 m SW	commercial	0.22
7	460 m SW	residential	0.08
8	340 m SW	residential	ND*
9	325 m SW	residential	ND
10	340 m NE	residential	0.51
11	490 m NE	municipal	0.18
12	430 m NNE	municipal	ND/ND**
13	160 m NE	C.G.E.	0.21
14	250 m NE	commercial	0.47
15	570 m S	residential	ND
16	415 m S	commercial	0.10
17	475 m SE	residential	0.10
18	275 m SE	residential	0.16
19	315 m S	residential	0.10
20	170 m SSE	municipal	1.3/2.7**
21	400 m N	C.G.E.	2.9
22	285 m N	C.G.E.	3.7
23	210 m NW	C.N.R.	0.27
24	65 m WSW	C.P.R.	210.0
25	50 m S	C.G.E.	0.36
26	30 m E	C.G.E.	130.0
27	150 m N	C.G.E.	13.0*
28	60 m NE	C.G.E.	32.0/25.0**
29	110 m S	C.G.E.	31.0
30	175 m E	C.P.R.	400./280.**
31	355 m E	C.P.R.	1.2
32	515 m ESE	municipal	0.10
33	280 m WSW	residential	0.07
34	485 m W	school	ND
35	200 m W	C.P.R.	0.52
36	control (urban) 2.2 km WSW	residential	ND
37	control (urban) 3.8 km WNW	commercial	ND
38	control (urban) 9.0 km WSW	municipal	ND
39	control (rural) 18. km NW	municipal	ND
40	control (rural) 36. km NW	government	ND
Provincial Guideline: not to exceed			50.0

*ND - not detected, less than analytical detection limit of 0.01 ppm.

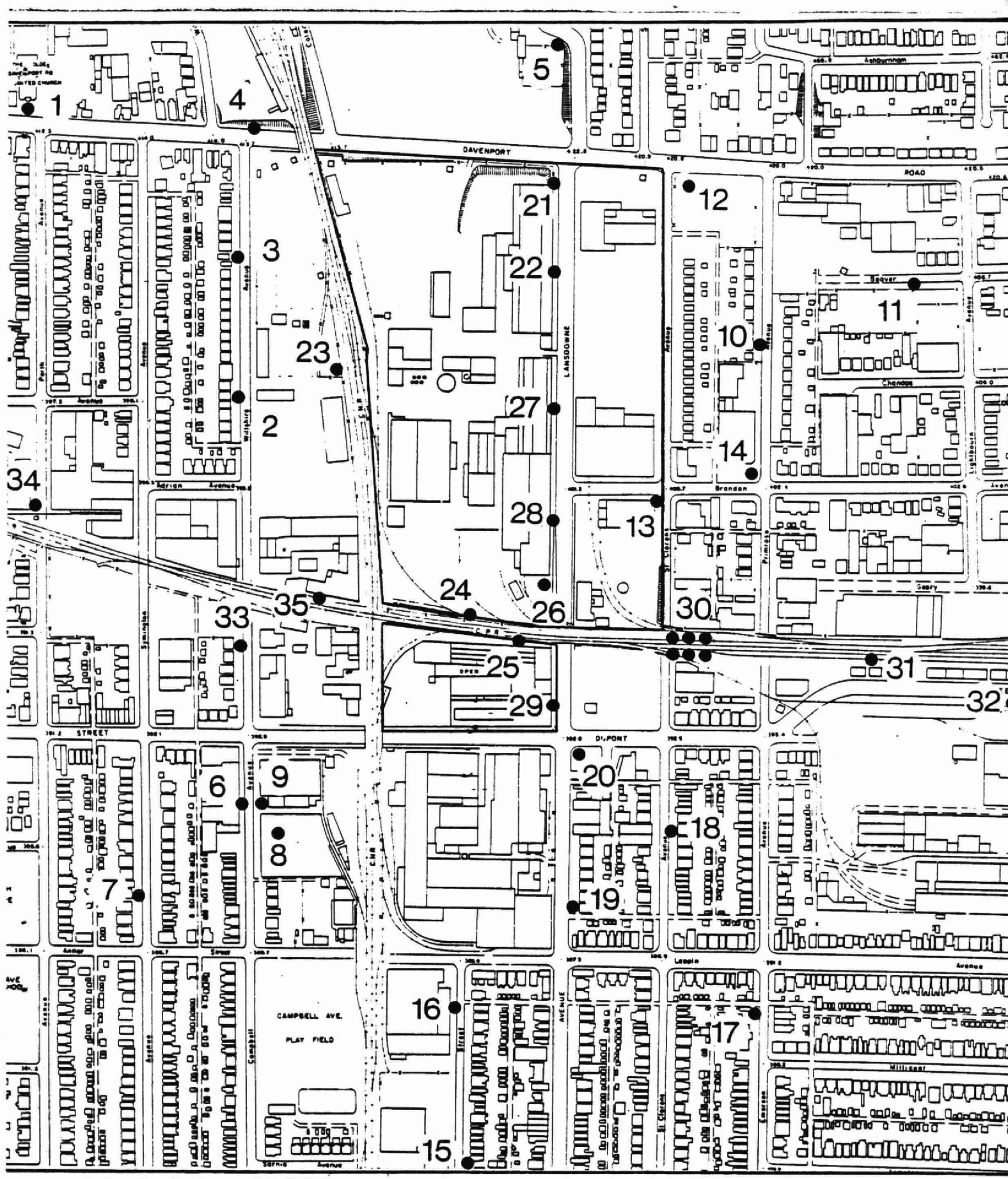
** - sample collected and analyzed in duplicate, both results reported.

t - parts per million, dry weight.

TABLE 2: PCB Concentration of Surface Soil (0-5 cm), Re-sample in the Vicinity of Site 30.

Sample Location Relative to Site 30			*PPM* PCB*
Site 30, Sampled May 17, 1984	*rep*	*1*	*400*
		2	*280*
Resample Site 30, August 24, 1984	*rep*	*1*	*4.5*
		2	*4.0*
10 m E	*rep*	*1*	*3.5*
		2	*3.0*
10 m W	*rep*	*1*	*6.1*
		2	*1.7*
Mean, N Side of CPR tracks			*3.8*
S Side of Tracks, Opposite Site 30 (August 24)	*rep*	*1*	*2.1*
		2	*1.8*
10 m E	*rep*	*1*	*2.2*
		2	*2.1*
10 m W	*rep*	*1*	*1.8*
		2	*1.9*
Mean, S side of CPR Tracks			*2.0*
Mean, May 17 Samples			*340*
Mean, August 24 Samples			*2.9*
MOE Guideline, Not to Exceed			*50*

** parts per million, Aroclor 1260, dry weight.*



- 36 2.2 km WSW
- 37 3.8 km WNW
- 38 9.0 km WSW
- 39 18km NW
- 40 36km NW

Figure 1: Location of PCB Soil Sample Sites.

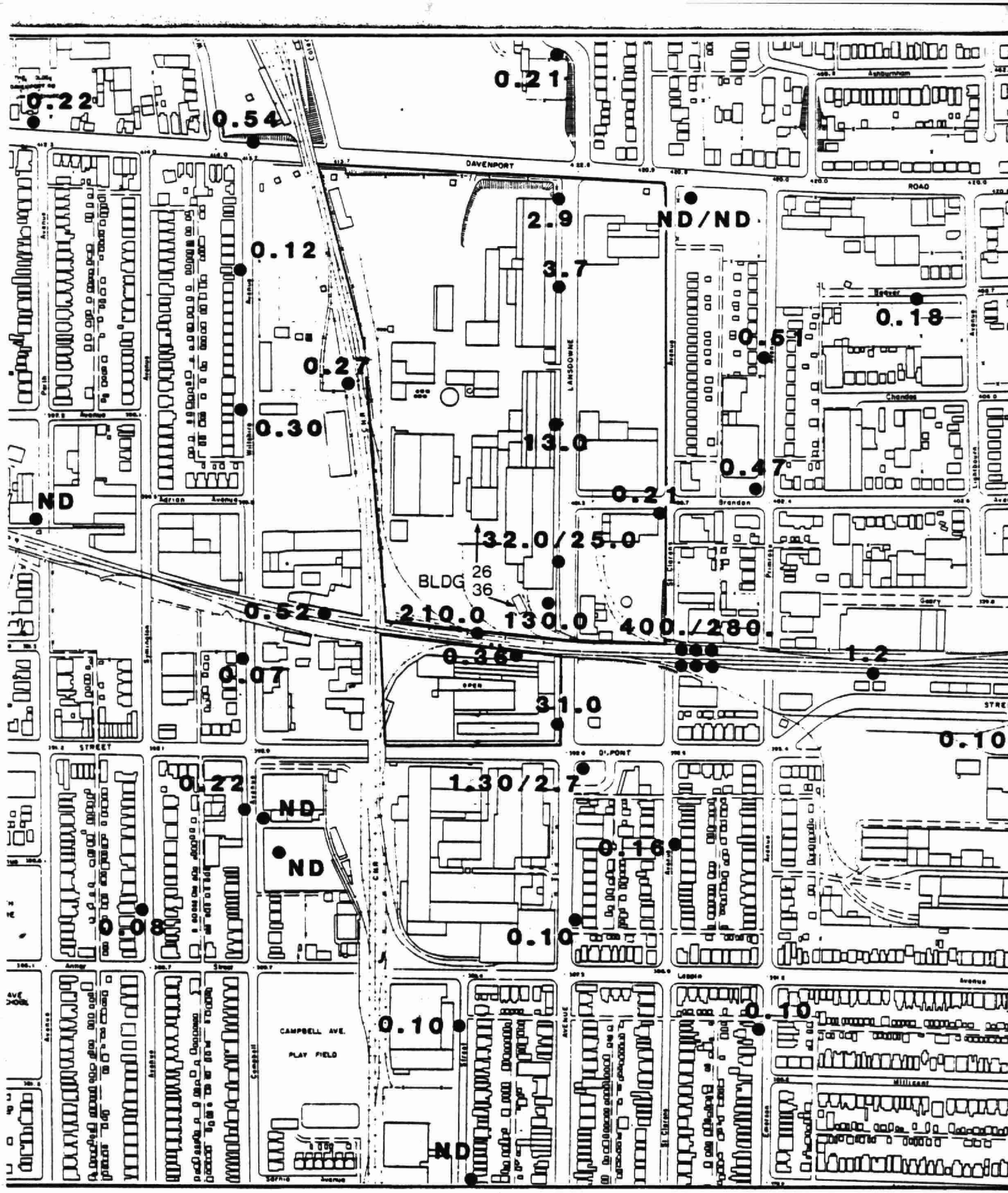


Figure 2: PCB Concentration (PPM) in Soil (0-5 cm)

APPENDIX 1

Description of Soil Sample Locations

Map No.		*Description*
1.	*church:*	*front lawn of Davenport-Perth United Church*
2.	*residential:*	*front lawn of 30 Wiltshire Ave.*
3.	*residential:*	*front lawn of 72 Wiltshire Ave.*
4.	*municipal:*	*1 m N of sidewalk, N side of Davenport Rd., opposite Wiltshire Ave.*
5.	*municipal:*	*between sidewalk and black iron fence at the bend in Lansdowne Rd., N of Davenport Rd.*
6.	*commercial:*	*60 m S of Dupont St., W side of Cambell Ave., opposite Duesbury-Jarrett Lithography.*
7.	*residential:*	*front lawn of 266 Symington Ave.*
8.	*residential:*	*back yard of 2 Antler St., Unit 40*
9.	*residential:*	*side garden adjacent to 2 Antler St., Unit 40.*
10.	*residential:*	*front lawn of 80 Primrose Ave.*
11.	*municipal:*	*S side of Beaver Ave., on grassy strip S of sidewalk, opposite 92 Beaver Ave.*
12.	*municipal:*	*NW corner of small municipal park, SE corner of St. Clarens Ave. and Davenport Rd.*
13.	*C.G.E.:*	*SW corner of Brandon Ave. and St. Clarens Ave.*
14.	*commercial:*	*NW corner of Primrose Ave. and Brandon Ave.*
15.	*residential:*	*front lawn of 17 Ward St.*
16.	*commercial:*	*SW corner of Ward St. and Lappin Ave., ½ way between fire hydrant and entrance to American Standard.*
17.	*residential:*	*front lawn of 178 Emerson Ave.*
18.	*residential:*	*front lawn of 741 St. Clarens Ave.*
19.	*residential:*	*front lawn of 945 Lansdowne Ave.*

Map No.		Description
20.	municipal:	center of grassy area at TTC turnaround, SE corner of Dupont St. and Lansdowne Ave.
21.	C.G.E.:	10 m N of bus stop, SW corner of Lansdowne Ave. and Davenport Rd.
22.	C.G.E.:	30 m N of C.G.E. vehicle entrance on W side of Lansdowne Ave.
23.	C.N.R.:	W side of C.N.R. tracks, adjacent to fence by transformer station.
24.	C.P.R.:	N side of C.P.R. tracks, immediately W of fence/gate to C.G.E. crossing.
25.	C.G.E.:	S side of C.P.R. tracks, adjacent to C.G.E. bldg., by second hydro post W of Lansdowne Ave.
26.	C.G.E.:	grassy area at NW corner of Lansdowne Ave. and C.P.R. overpass, 30 m E of bldg. 36.
27.	C.G.E.:	adjacent to 4th tree S of C.G.E. vehicle entrance on W side of Lansdowne Ave.
28.	C.G.E.:	W side of Lansdowne Ave., 70 m N of C.P.R. tracks below two large outside bldg. vents.
29.	C.G.E.:	immediately N of entrance to C.G.E., NW corner of Lansdowne Ave. and Dupont St.
30.	C.P.R.:	N side of C.P.R. tracks, 75 m E of Lansdowne Ave.
31.	C.P.R.:	S side of C.P.R. tracks in grassy area at edge of embankment behind DX gas bar, on Dupont St.
32.	municipal:	S side of Dupont St., 20 m W of entrance to Gallaria Plaza.
33.	residential:	front lawn of 336 Cambell Ave.
34.	school:	2 m W of Long Jump pit in SE corner of school yard of Brother Edmund Rice Secondary School.
35.	C.P.R.:	N side of C.P.R. tracks, between main tracks and abandoned siding, immediately S of Union Felt Products and 70 m W of CPR/CNR intersection.
36.	residential:	front yard of 344 Annette St.

Map No.		Description
37.	commercial:	NE corner of St. Clair Ave. W and Scarlett Rd.
38.	municipal:	W of entrance to Etobicoke Public Library (Etonville Branch), SE corner of Burnhamthorpe Rd. and The East Mall.
39.	municipal:	20 m N of ticket booth, Claireville Conservation Area, NW of Indian Line and Steeles Ave.
40.	government:	outside field garden, Phytotoxicology Controlled Environment Laboratory (MOE) in Brampton.